

## MISSION CARTRIDGE

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to munitions and in particular to a mission  
5 cartridge for smart weapons.

Increasingly weapon systems deliver weapons equipped with on-board computers. Such weapons include, but are not limited to, missiles and smart bombs. The on-board computers allow execution of relatively complex and data-dependent missions.

10 One method of supplying the required mission data to the on-board computer of a weapon is transmission of the required data after launch of the weapon, for example, transmission by an operator. This method is most suitable for supplying a weapon with real-time mission data. Weapons using this method are susceptible to in-flight neutralization by jamming of the data transmission.

15 Another method of supplying mission data to the on-board computer of a weapon is the downloading of all mission information from the weapon control system to the individual weapon proximately to the actual use of the weapon. For example, a pilot of an airplane downloads mission data such as target coordinates during flight or proximately to the moment of weapon launch. One weakness of this  
20 method is that often the amount of data that needs be transferred to a weapon system is quite large. An alternative is that as the weapon is loaded onto the launch platform, mission data is downloaded onto on-board storage media associated with the on-board computer. The greatest disadvantage of such a method is that intelligence and command assets are exposed to interception or may be otherwise compromised.

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A known disadvantage of weapons equipped with on-board computers is the difficulty in keeping the software (Operation Flight Program, OPF) up to date. As with any complex software, continuous development and improvement means that updated versions appear in the time scale of months. As a result any given OPF quickly  
5 becomes outdated. In a military environment where large numbers of weapons are stored for extended periods of time, it is logistically complex and practically difficult to update and maintain all weapons at the most recent OPF version.

It would be highly advantageous to have a robust and safe method for supplying mission data to munitions. It would also be highly advantageous to have a  
10 convenient method of ensuring that weapon software, such as OPF, will be of a most updated version when used.

#### SUMMARY OF THE INVENTION

The above and other objectives are achieved by the method, the cartridge and  
15 weapon provided by the present invention.

According to the teachings of the present invention there is provided a mission cartridge comprising a memory unit functionally associated with a connector element, that is, where the input and output channels of the memory unit are accessible through the connector element. The connector element is one part of a connector of which  
20 many types are well known to one skilled in the art. Such connectors include but are not limited to bayonet type connectors, quick-release connectors and screw connectors. One specific connector is a 35-pin D38999/26WD35PN connector provided by, for example, Amphenol Inc. (Wallingford, Connecticut, USA).

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Preferably information stored on the memory unit is randomly accessible (as opposed to serially accessible). Preferably the memory unit is a rewritable memory unit. According to a feature of the present invention the memory unit is a programmable memory unit such as flash-based data storage (for example, as  
5 manufactured by M-Systems Ltd., Kfar Saba, Israel).

According to a feature of the present invention the memory unit stores mission data, an OPF or an OPF update.

According to a feature of the present invention, on the outer surface of the memory unit is a labeling area. The labeling area allows markings to be affixed or  
10 otherwise brought in to the labeling area to allow differentiation of any two otherwise externally identical mission cartridges.

According to the teachings of the present invention there is also provided a weapon of the present invention. A weapon of the present invention comprises three parts.

15 The first part of the weapon of the present invention is the weapon body and includes a payload and an on-board computer functionally associated with a first connector element.

The second part of the weapon of the present invention is a mission cartridge (as described hereinabove) and includes a memory unit functionally associated with  
20 second connector element. The first connector element and second connector element are configured to mate. Upon mating of the first and second connector elements, the memory unit and on-board computer are functionally associated, allowing the on-board computer to access information stored in the memory unit. According to a feature of the present invention, by access is meant that amongst other functions, the

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on-board computer is configured to read information already stored in the memory unit. According to another feature of the present invention, by access is meant that amongst other functions, the on-board computer is configured to store information onto the memory unit.

5           The third part of the weapon of the present invention is a mission loader and includes a memory unit writer and a third connector element. The third connector element is configured to reversibly mate with the second connector element and is therefore substantially similar or substantially identical to the first connector element. Upon mating of the second and third connector elements, the memory unit and the  
10   memory unit writer are functionally associated, allowing the memory writer to access the memory unit. According to a feature of the present invention, by access is meant that amongst other functions, the memory writer is configured to store information onto the memory unit. According to another feature of the present invention, by access is meant that amongst other functions, the memory writer is configured to read  
15   information already stored in the memory unit.

          Preferably information written by the memory writer to be stored on the memory unit, and thereafter used by the on-board computer includes but is not necessarily limited to mission data, OPF or OPF updates. In some embodiments mission data, OPF or OPF updates are considered to be additional parts of the weapon  
20   of the present invention.

          According to a feature of the weapon of the present invention, the on-board computer is also configured to record data, such as data acquired during flight, onto a mission cartridge with which there is a functional association through the respective connectors.

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According to the teachings of the present invention there is also provided a method of attacking a target comprising a) providing a weapon of the present invention as described above; b) mating the second connector element with the third connector element; c) storing information (mission data, OPF or OPF updates) in the memory unit using the memory unit writer; d) detaching the second connector element from the third connector element; e) mating the second connector element with the first connector element; and f) the in-flight computer uses the information stored in the memory unit to attack the target.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, where:

FIG. 1 is a schematic depiction of a mission cartridge of the present invention;

5 and

FIGS. 2 are a schematic depiction of a weapon of the present invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a mission cartridge, a weapon and a method of using  
10 the same. The principles and operation of the present invention are better understood with reference to the drawings and the accompanying description.

In Figure 1 is depicted a mission cartridge 10 of the present invention. Memory unit 12 is a flash-based data storage element contained within a protective casing. One skilled in the art is aware that flash-based data storage elements are  
15 standard products that can be purchased in various sizes and with various data storage

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capacities. The leads, ports and electrical connections of memory unit 12 pass through cartridge connector element 14 and are in electrically conductive connection to pins 16. Cartridge connector element 14 is a male connector element of a 35-pin D38999/26WD35PN connector (Amphenol Inc., Wallingford, Connecticut, USA).

5 Apart from pins 16, cartridge connector element 14 includes a rigid guide collar 18, alignment tabs 20 and rotatably attached tightening collar 23.

On the external surface of memory unit 12 is found labeling area 22. Labelling area 22 in Figure 1 is a polymer surface on which a "permanent marker" can be used to write annotations.

10 In Figures 2 is depicted a weapon of the present invention.

In Figure 2A are depicted a mission cartridge 10 together with a mission loader 24. Mission loader 24 includes a memory writer 26; a loader connector element 28 in communication with memory writer 26 through cable 30; an operation flight program storage unit 32 and a mission data storage unit 34 both in communication with  
15 memory writer 26 through cables 36.

In Figure 2A memory writer 26 is a computer provided with software and hardware allowing transfer and writing of information to a memory unit 12 of mission cartridge 10.

Loader connector element 28, not depicted in detail in Figure 2A, is a female  
20 connector element of a 35-pin D38999/26WD35PN connector (Amphenol Inc., Wallingford, Connecticut, USA). As is known to one skilled in the art, loader connector element 28 is reversibly mateable to cartridge connector element 14 (as depicted in Figure 2A).

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Operation flight program storage unit 32 is physically a hard disk drive and stores the most recent version and updates of the operation flight program (OFP) of a given weapon. Developers continuously upgrade and improve the OFP.

Mission data storage unit 34 is physically a hard disk drive and stores mission  
5 operational data for many missions. Mission operational data is continuously updated, improved and optimized for example as a result of intelligence, tactical or command decisions.

In Figure 2B is depicted mission cartridge 10 together with a weapon body 38. Weapon body 38 is depicted in partial cut-out to expose the internal volume of  
10 weapon body 38 and components therein. Weapon body 38 includes an in-flight computer 40; a payload 42 in communication with in-flight computer 40 through cable 44; a control surface 46 in communication with in-flight computer 40 through cables 48, and a weapon body connector element 50 in communication with in-flight computer 40 through cables 52.

15 Weapon body connector element 50, not depicted in detail in Figure 2B, is a female connector of a 35-pin D38999/26WD35PN connector (Amphenol Inc., Wallingford, Connecticut, USA). As is known to one skilled in the art, weapon body connector element 50 is reversibly mateable to cartridge connector element 14 (as depicted in Figure 2B).

20 In Figure 2B weapon body 38 is depicted attached to a wing 54 of an aircraft.

When it is decided to use a weapon of the present invention, for each individual weapon, a mission cartridge 10 is provided. Cartridge connector element 14 is mated to loader connector element 28. In such a way, memory writer 26 is functionally associated with memory unit 12 of mission cartridge 10. An operator uses

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memory writer 26 to store a most recent or most appropriate OPF from operation flight program storage unit 32 to memory unit 12. The operator also selects from the missions stored mission data storage unit 34 one or more mission operational data. The operational data of the selected mission or missions is stored by memory writer 5 26 on memory unit 12. Mission cartridge 10 is then disconnected from memory writer 26. The operator preferably marks mission cartridge, for example by writing with a marker on labeling area 22.

When it is necessary to perform a mission, an appropriately loaded mission cartridge 10 is selected. Cartridge connector element 14 is mated to weapon body 10 connector element 50. In such a way, in-flight computer 40 is functionally associated with memory unit 12 of mission cartridge 10. In-flight computer 40 is then activated to read and implement a most recent version of the OPF stored on mission cartridge 10. When it is necessary to actually launch the weapon, the operator selects one of the missions stored on mission cartridge 10. The corresponding mission operational data 15 is read from mission cartridge 10 and implemented by in-flight computer 40. In-flight computer 40 uses control surface 46 to perform the mission properly, and when appropriate, to activate payload 42.

In an embodiment of the present invention, a mission cartridge of the present invention, such as 10, is used together with an appropriately modified weapon of the 20 present invention to record data, for example flight data acquired during training missions. Such a mission cartridge is substantially identical to that described above. However, appropriate modifications are made so as to allow writing or recording of data. This is most easily implemented by providing in-flight computer 40 with



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appropriate software instructions. After mission cartridge 10 has been attached to weapon body connector element 50, in-flight computer 40 writes the desired data during a flight. When the flight is over, and if mission cartridge 10 has not been destroyed (*e.g.* by actual use of the weapon to which mission cartridge 10 was  
5 attached) mission cartridge 10 is detached and attached to a memory reader. The memory reader reads the flight data recorded on mission cartridge 10 for use. As is clear to one skilled in the art, a memory reader is substantially similar to memory writer 26 depicted in Figure 2A. In fact memory writer 26 can be considered a combined memory reader / writer for the purposes of the present invention. There is  
10 thus no need for a more detailed description of a memory reader according to the present invention.

As is clear to one skilled in the art the present invention has many advantages.

When use is made of the present invention, there is no need to be concerned with the logistics of updating the OPF of any weapon system made in accordance with  
15 the teachings of the present invention. Rather it is clear that every weapon launched uses the most recent or most up to date OPF available. Software updates are not done in the proximity of the weapon body which is generally unsafe, but at a safe location.

Mission operational data can be loaded onto mission cartridges at a location remote from where the weapons are armed. Combat crews need not be concerned with  
20 detailed intelligence and the input of data. Intelligence and command units need not be exposed to unnecessary danger. Intelligence and operational decisions are not susceptible to interception.

Data is easily recorded from weapons and the weapons do not require significant modification for recording data. The same mission cartridge is used for

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both recording flight data from a weapon and for providing a weapon with mission data, a clear logistic advantage.

The present invention simplifies logistics by using easily available standard connectors. The present invention is very robust and allows simple retrofitting to existing weapons system. A mission cartridge of the present invention can be reused  
5 virtually endlessly and is very compact. Further a mission cartridge can more easily contain a plurality of missions due to the possibility of using random data-access.

An additional advantage of the instant invention is that upgrading of the mission cartridge itself is simple. An on-board computer and connector element of the weapon body remain unchanged for years. However, the mission cartridge itself  
10 improves over the years and can continuously be changed as technology improves. The use of a standard connector allows this to be easily performed. One skilled in the art is aware that in the time scale of a few months improvements in memory unit technology reduces prices, increases capacities and increases information access  
15 speeds. Using the present invention, these improvements are implemented in existing weapon bodies at a reasonable cost. More importantly, these improvements are logistically simple to implement, performed only at the moment of use and not in a weapons storage depot and the like.

The use of the present invention also allows the transfer and use of large  
20 amounts of data. Information is stored onto a mission cartridge of the present invention spatially remotely from the weapon body and temporally remotely from the time of use, if so desired. At the same time, attachment of the cartridge to the weapon body is very quick, in the order of one or two seconds. Thereafter, loading of

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information from the cartridge to the on-board computer of the weapon can occur automatically as other functions are performed. Thus the time required to transfer the required information has a negligible operational influence for virtually any amount of data. This is in contrast to methods known in the art where data transmission  
5 bandwidth or data download time is significant and thus has operational significance and limits the amount of information that can be transferred.

While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications and other applications of the invention may be made.